

STUDIES IN BLOOD PRESERVATION*

SOME EFFECTS OF CARBON DIOXIDE

By MARGARET E. SMITH, ELIZABETH TUTHILL, CHARLES R. DREW,[†] AND JOHN SCUDDER

(From the Surgical Pathology Laboratory, College of Physicians and Surgeons, Columbia University, New York)

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Various changes in shed blood have been reported; only a few will be cited. When blood is exposed to ordinary atmosphere, carbon dioxide is liberated (7) with a resultant increase in pH (6). Another change is in the formation of ammonia. According to Conway (3), ammonia is present only in very small concentrations, if at all, in circulating blood. In shed blood, however, the ammonia concentration rapidly increases, attaining within a few minutes values given as "normal" by most investigators; thereafter, its formation is at a slower rate.

Conway (3) and Conway and Cooke (4) have shown that when blood is shed into an atmosphere of carbon dioxide the concentration of ammonia remains at a low value for some hours.

The purpose of the present investigation is to examine the effect of carbon dioxide in relation to changes in concentrations of ammonia, potassium, and sodium in the plasma of sterile citrated blood occurring over a period of days.

Methods

In each of eight experiments, blood was obtained from a different individual in the usual manner; one-half of the sample was drawn into an atmosphere of carbon dioxide, while the control was collected in air. On the samples so taken, from four to six deter-

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[†] Fellow in Surgery, Rockefeller Foundation.

minations of the ammonia content were made at intervals during a 2 week period.

The data of one of these experiments are shown graphically in Fig. 1. In this experiment, ten 50 ml. centrifuge tubes with a diameter of 2.5 cm. were used as containers. Carbon dioxide from a cylinder, filtered through sterile cotton, was introduced into the bottom of five centrifuge tubes so as to displace the air. To each were added 2.5 ml. of 3.5 per cent sodium citrate and 22.5 ml. of blood. For the carbon dioxide experiments, the blood was

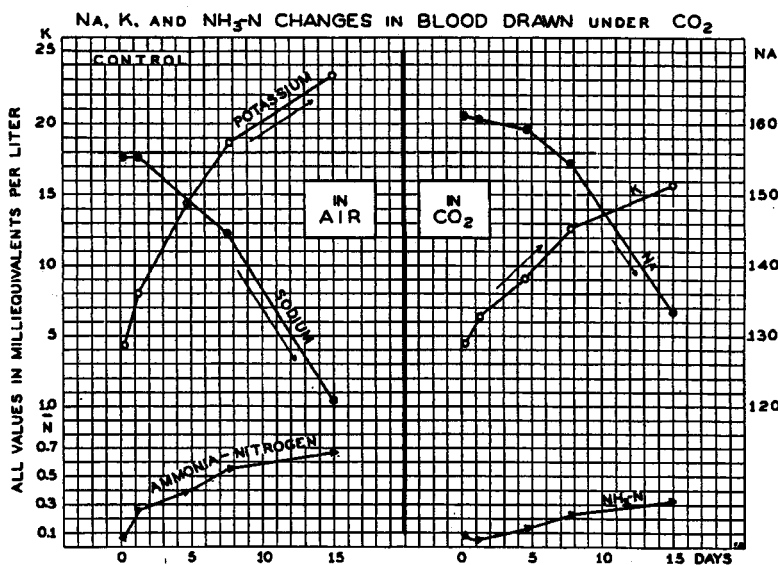


FIG. 1. Concentrations of ammonia nitrogen, potassium, and sodium in plasma of preserved blood, after collection in air (control) and in carbon dioxide. In control, pH 7.76 to 7.69; in CO₂ 7.48 to 7.17.

admitted directly to the bottom of the centrifuge tubes; in the controls, the blood was allowed to flow in at the top. Both sets were closed with sterile rubber stoppers, sealed with paraffin, and placed in a refrigerator at 4°. At intervals during a 2 week period, a carbon dioxide tube and its control were removed from the refrigerator and centrifuged. The supernatant plasma was then drawn off for analyses.

The ammonia was determined by the method of Conway (3), the potassium by a modification (9) of the argenticobaltinitrite

method of Breh and Gaebler (1), and the sodium by the method of Butler and Tuthill (2). Determinations of pH were made on six of the ten samples, with the glass electrode of MacInnes and Longworth (5). Measurements of ammonia, sodium, pH, and the development of color in the potassium determinations were made in a constant temperature room, $20.5^{\circ} \pm 1^{\circ}$.

Results

In each instance the concentration of ammonia in the blood taken in carbon dioxide is less than in the similarly treated control. In both, the concentration of ammonia gradually increases throughout the 2 week period; but at any time, it is consistently less in blood collected in carbon dioxide. Similar conditions are found for potassium and sodium; namely, changes in the concentrations occur during storage, but these are definitely less when the blood is taken in carbon dioxide.

The curves of Fig. 1 are typical in form for the changes observed. At the end of the experiment 27 per cent of intracellular potassium had diffused out in the sample collected in air in contrast to only 16 per cent in the sample collected in carbon dioxide. In a comparison of potassium values, the interfacial area between plasma and cells should be stated (8).

It is evident that the taking of blood directly into an atmosphere of carbon dioxide is effective in retarding changes in the concentrations of plasma ammonia, sodium, and potassium which occur during storage. Such procedure might lengthen the period during which preserved blood could be used for transfusions.

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